

Appl. No.: 10/629,397  
Amdt. Dated: April 6, 2007  
Reply to Office Action of: February 8, 2007

## REMARKS/ARGUMENTS

### A. Supplemental Remarks and Arguments

#### 1. Claims

Claims 1-19 are pending in the application. Claims 9-19 were previously withdrawing as the result of a restriction requirement, the withdrawn being made with the reservation of applicants' right to file a divisional application on the withdrawn claims. *Claims 1-8 remain in the application.*

Claims 1-8 have been rejected in the Office Action of February 8, 2007.

Claims 1, 4, 5 and 8 have been amended and are now directed solely to a calcium fluoride optical crystal.. Claims 2, 3, 6 and 7 have been canceled.

#### 2. Additional Remarks

Claim 1 has been amended to further state that the claimed calcium fluoride crystal not only has the limitation that the amended Cl level is less than 0.2 ppm, but that the crystal also has the limitation that the Cl + S level of the crystal is less than 0.3 ppm. Although Sakuma is silent not only about the Cl concentration in his crystals, but also about the S concentration in his crystals, based on work described in the present application it is applicants belief that the sulfur level in the crystal should be less than 0.2 ppm with the combined Cl + S concentration being less than 0.3 ppm. Without being held to any particular theory, as a crystal is exposed to laser radiation for extended periods of time there may occur localized migration between Cl and S within the crystal lattice. The ions  $\text{Cl}^-$  and  $\text{S}^{2-}$  have similar ionic radii, with  $\text{Cl}^- = 1.81$  Angstroms and  $\text{S}^{2-} = 1.84$  Angstroms. Such migration would change the form of the crystal structure by second phase precipitation as explained below which could quickly render the crystal unusable for <200 nm lithography. Applicant's Figure 16, crystal C#3 has a Cl concentration of approximately 0.05 ppm and an S concentration of 0.5 ppm as indicated. This crystal produced no scatter. Bardsley, page 911, last complete paragraph, indicates that scatter was found at 20 ppm CaS. Bardsley gives not lower limit, but since applicants C#3 at 0.5 ppm S did not produce scatter, the upper limit for allowed S is somewhere between this 0.5 ppm and 20 ppm. Since applicants

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amended claim 1 states that  $Cl = <0.2$  ppm and  $Cl + S = <0.3$ , the maximum S concentration, if  $Cl = 0$  ppm, is 0.3 ppm.

Bardsley, page 912, last paragraph, indicates that scattering centers are dependent on the formation of "precipitates" in the crystal. That is, Bardsley indicates that one can form a second phase such as  $CaCl_2$  or  $CaS$  within a  $CaF_2$  structure if the Cl or S concentration exceeds the limit of solid solubility. Since ion migration can occur within a crystal lattice, and which may be facilitated by the application of laser light, Cl or S ion could locally migrate to change the localized concentration of Cl or S such that scattering would result.

Further considering Sakuma in consideration of Bardsley as representing knowledge in the art and claim 1 as amended, applicants submit that Examiner's assumption that Sakuma has the low Cl level as claimed by applicants is submitted to be unsupported by the Sakuma specification. Consequently, applicants submit that it is proper for the Examiner to withdraw all rejection in view of Sakuma whether taken alone or in combination with other art.

**B. Original Remark and Argument filed April 5, 2006**

**1. Drawings**

The Examiner has not indicated in the accompanying form PTO-948 that the formal drawings previously submitted have been approved. Without specific rejection from the Examiner applicants will deem they have been approved.

**2. Claims**

Claims 1-19 are pending in the application. Claims 9-19 were previously withdrawing as the result of a restriction requirement, the withdrawn being made with the reservation of applicants' right to file a divisional application on the withdrawn claims. *Claims 1-8 remain in the application.*

Claims 1-8 have been rejected in the Office Action of February 8, 2007.

**2. § 102 Rejections**

The Examiner has rejected claims 1 – 8 under 35 U.S.C. § 102(b) as being anticipated by Sakuma, EP Publication 1 026 548, optionally with Bardsley, et al

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(Optical Scattering In Calcium Fluoride Crystal) Brit. J. Appl. Phys. 1965, Vol. 16, pp. 911 – 912. Applicants traverse the rejection.

First, regarding Bardsley, The Examiner has indicated in the Office Action at page 3, lines 4-11, that Bardsley teaches that any amount of chlorine and sulfur would produce scatter. *Assuming for argument's sake the Examiner is correct, then in fact Bardsley teaches away from the present invention because applicants have found that no scatter is produced at chloride levels <0.25 ppm Cl.* The same holds with regard to sulfur. Bardsley does not mention any lower levels of sulfur that could be present without producing sulfur. Applicants' data as represented by Fig. 16 indicates that a crystal with ~0.1-0.15 ppm Cl and ~0.05 ppm S does not produce scatter. Also a crystal with ~0.15 ppm Cl and ~0.5 ppm S does not produce scatter.

Accordingly, Using the Examiner's argument one must conclude that Bardsley teaches away from the present invention because there is a level for both Cl and S at which no scatter is produced.

Further, Bardsley indicates that chloride levels of 50 ppm (see page 911, last paragraph) were found to produce scatter. There is no indication in Bardsley as to how low one must go to avoid scatter. Going from the 50 ppm Cl level of Bardsley to the <0.25 ppm level taught by applicants is an 80-fold reduction in chloride content (almost 2 orders of magnitude). In addition, Bardsley appears at the dawn of laser of lasers and at that time when lasers did not operate below 200 nm for lithographic purposes. Consequently, there was no way for Bardsley to determine what level of chloride would not produce scatter at, 200 nm wavelengths.

*Consequently*, in view of the foregoing facts and arguments, applicants submit that Bardsley would neither of itself anticipate the claimed invention nor if combined with Sakuma necessarily result in a presumption that Sakuma has attained a Cl level <0.25 ppm Cl.

Second, regarding Sakuma, applicants submit that even though both Sakuma and the claims of the present application, as previously amended, recite transmission in terms of "%/cm", the claimed subject matter is not anticipated by Sakuma. The Examiner states that since Sakuma recites a crystal having a transmission of >99.5%, it is presumed that the Sakuma crystal is scatter-free and that it would have a low chlorine level. This is an invalid assumption in which the Examiner uses applicants' own teaching against them.

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Sakuma is complete silent on the chloride levels of the crucibles used to prepared the crystals described in EP 1 026 548. Imparting a low level of chloride as taught by applicants is adding to Sakuma that which is not present either explicitly or implicitly. Applicants' Figure 16 indicates that a chloride level as low as 0.3 ppm is sufficient to impart scatter to the crystal.

If one uses the highest internal transmittance value given by Sakuma in Table 1, which value is 99.9 % and calculates the internal transmittance for a 20 cm crystal using the equation Sakuma gives in column 5, line 12, for a crystal losing 0.1% transmittance per centimeter the overall internal transmittance is 98% per 20cm. Applicants submit that the missing 2% is due to scatter losses in the crystal. If a red laser inspection light where passes through the Sakuma crystals this missing 2% would show up as scatter. Sakuma may measure transmittance, but there is indication that the transmitted light is not scattered, If one used an appropriate detector, all the light passing through the crystal could be detected.

In contrast to Sakuma, applicants have clearly indicated that the crystals of the present invention are scatter-free. As applicants have states in Paragraph [0044]

"In a scatter-free calcium fluoride crystal disk blank one would not see any red streak in the crystal since there would be nothing to reflect or scatter the light in the middle of the crystal."

Throughout their specification and in the Figures applicants have indicated and shown that the crystals of the present invention are scatter-free. Consequently, the 2% loss experienced by the Sakuma crystals would not occur in applicants' crystals and as a result there is no broadening of the inspection beam. The presence of scatter is shown in applicants' Figure 9B.

Fifth, Sakuma indicates that when his polycrystalline calcium fluoride is used to form a calcium fluoride single crystal a scavenger is used. However, the only impurities that Sakuma mentions that are removed from the polycrystalline material are lead, water and oxygen. Further, there is no mention in Sakuma that the crucibles he used have been purified to have a chloride level that is sufficiently low such that the crystal produced using the crucible has a chloride level less and 0.3 ppm. Consequently, while Sakuma teaches removing lead, oxygen and water, *there is no teaching about the removal of chloride, or the prevention of having chloride*

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*contaminate of the crystal by diffusion from the crucible preferably by reducing/removing chloride from the crucible prior to making the crystal.*

### 3. § 103 Rejections

The Examiner has rejected claims 1 - 8 under 35 U.S.C. § 103(a) as being unpatentable over Sakuma, et al (EP 1 026 548) in view of Hammond, et al (6,093,245) for reasons set forth in the Office Action. Applicants' traverse the rejection.

First, applicants note that the Examiner has admitted that Sakuma does not disclose the chlorine concentration in the calcium fluoride crystals of the '548 application.

Second, applicants further note that Hammond '245 teaches in column 3, lines 37-39, that:

"The crucible is then purified by a known high temperature chlorine process before the coating is applied."

Hammond '245 describes a process for sealing the pores of a crucible in order to prevent molten metal fluorine from either seeping out of the crucible or seeping into the pores of a crystal in order to prevent the a metal fluoride crystal, after it and the crucible have been cooled, from adhering to the crucible (see column 3, lines 20-27). Hammond defines what he means by the terms "pyrolytic carbon" and "glassy Carbon" in the specification in column 3, lines 12-16.

Hammond '245 does not mention diffusion of any materials in the crucible through the coating into the molten metal fluoride. However, since the crucibles of Hammond have been purified using a chlorine process, *residual chlorine is present in the crucible after purification. As a result there is chlorine present in the crucibles that can diffuse through the coating during the coating process and/or during the process of making the metal fluoride crystal.* Diffusion during the coating process would be particularly disadvantageous to making calcium fluoride crystals for <200 nm application because chloride in the coating could be in direct contact with the molten metal fluoride and could diffuse into the molted metal fluoride.

Typically the manufacturer of the glass carbon crucibles report only metallic impurities is was indicated in the applicants response dated. Attached to this Response are two web pages (Attachments A and B), one from Graphite Die Mold Inc. mentioned in the '254 patent in column 5, Example 6, and the other from Tokai Carbon Co. Ltd.

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In both instances only metallic impurities are reported. No chloride level is reported, nor is the level of any other anionic impurity reported. Consequently, in view of the fact that Hammond '245 clearly states that the crucible is chlorine purified, applicants

submit that <sup>Sol.Ink</sup> the Hammond crucibles retain sufficient chlorine such that even after coating the crucibles can contaminate the metal fluoride crystals grown therein.

**THEREFORE**, in view of the facts and arguments presented above, applicants submit that the claimed invention is not obvious over the combination of Sakuma and Hammond, and applicants further submit that the claims as amended herein are patentable over Sakuma and Hammond. Consequently, applicants submit that it is proper for the Examiner to withdraw the 35 U.S.C. 103(a) of the claims

#### 4. Conclusion

Based upon the above amendments, remarks, and papers of record, Applicant believes the pending claims of the above-captioned application are in allowable form and patentable over the prior art of record. Applicant respectfully requests reconsideration of the pending claims 1-8 and a prompt Notice of Allowance thereon

Based upon the above amendments, remarks, and papers of records, applicant believes the pending claims of the above-captioned application are in allowable form and patentable over the prior art of record. Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Applicant believes that no extension of time is necessary to make this Reply timely. Should applicant be in error, applicant respectfully requests that the Office grant such time extension pursuant to 37 C.F.R. § 1.136(a) as necessary to make this Reply timely, and hereby authorizes the Office to charge any necessary fee or surcharge with respect to said time extension to the deposit account of the undersigned firm of attorneys, Deposit Account 03-3325.

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Please direct any questions or comments, or any further matter whose speedy resolution will facilitate prosecution, to Walter M. Douglas at 607-974-2431.

6 April 2007  
Date

<p><b>CERTIFICATE OF TRANSMISSION</b> <b>UNDER 37 C.F.R. § 1.8</b></p> <p>I hereby certify that this paper and any papers referred to herein are being transmitted by facsimile to the U.S. Patent and Trademark Office at 571-273-8300 on:</p> <p><u>6 April 2007</u> Date</p> <p><u>Walter M. Douglas</u> <u>6 April 2007</u> Walter M. Douglas Date</p>
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